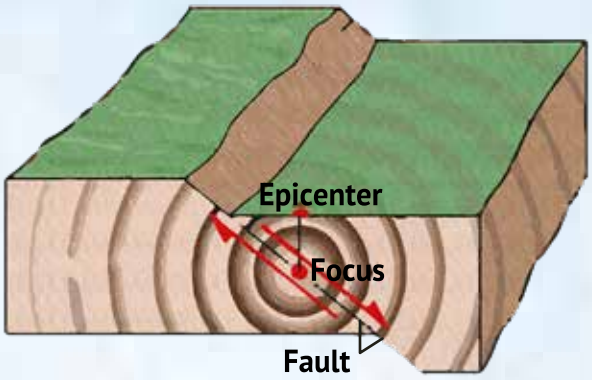
QUICK REVISION MODULE
(UPSC PRELIMS 2022) GEOGRAPHY

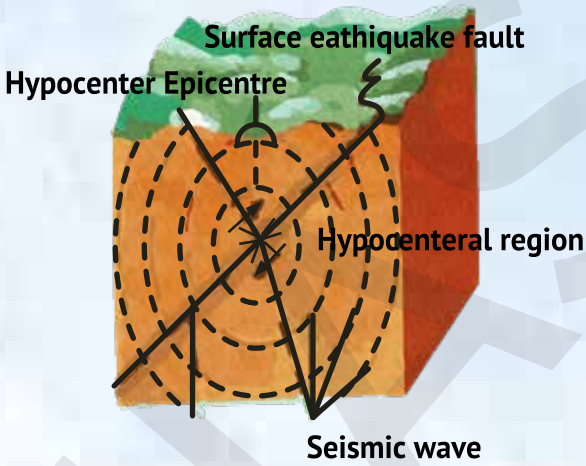
EARTHQUAKES AND TSUNAMIS

EARTHQUAKE

An earthquake in simple words is **shaking of the earth.** is caused **due to release of energy, generates waves that travel in all directions.**

FOCUS AND EPICENTRE OF AN EARTHQUAKE??





The **point where the energy is released** is called the **focus** of an earthquake, alternatively, it is called **the hypocentre. The point on the surface, nearest to the focus, is called epicentre.** It is the first one to experience the waves. It is a point directly above the focus.

Depth of Earthquakes

Earthquake focus depth is an important factor in shaping the characteristics of the waves and the damage they inflict.

- The **focal depth can be deep (from 300 to 700 km), intermediate (60 to 300 km) or shallow (less than 60 km).**
  - **Deep focus earthquakes are rarely destructive** because the wave amplitude is greatly attenuated by the time it reaches the surface.
  - **Shallow focus earthquakes are more common and are extremely damaging** because of their close proximity to the surface

FACTORS INFLUENCING EARTHQUAKES:

SEISMIC WAVES AND ITS MEASUREMENT

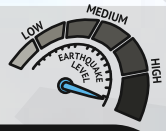
The waves generated by an earthquake are called the 'seismic waves' or 'earthquake waves' and are recorded by an instrument called the seismograph or the seismometer.

The earthquake events are **MEASURED** either according to the **magnitude or intensity of the shock.**

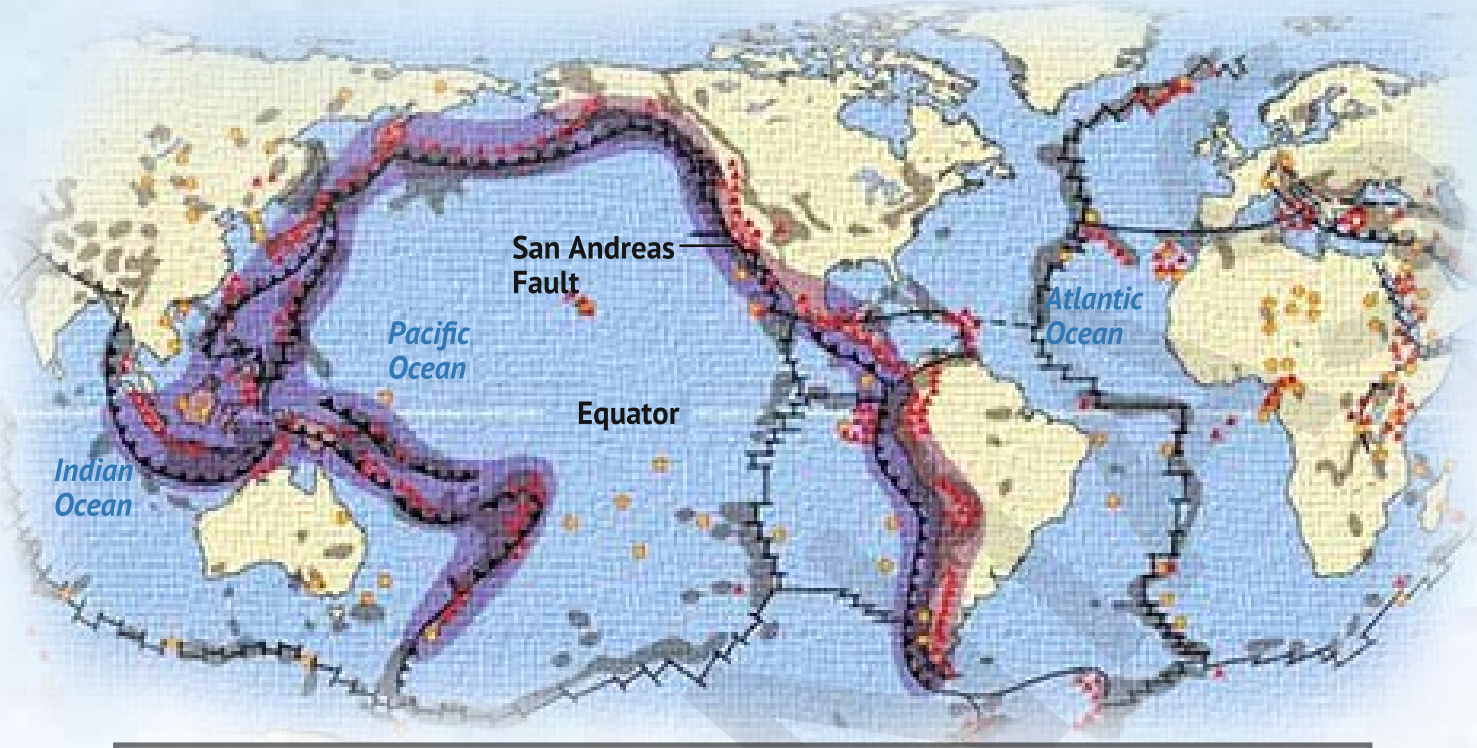
- Magnitude is the amount of energy released and is based on **the direct measurement of the size of seismic waves. The magnitude scale is known as the Richter Scale.**
- **Intensity of an earthquake is measured in terms of its effects on human life.**

The Mercalli intensity scale is a scale used for measuring the intensity of an earthquake. The intensity of an earthquake at a specific location depends on a number of factors LIKE: -

1.) the total amount of energy released
2.) the distance from the epicentre
3.) the types of rocks and the degree of consolidation

Characteristic	 Mercalli Scale	 Richter Scale
Measures	The effects caused by earthquake	The energy released by the earthquake
Measuring Tool	Observation	Seismograph
Calculation	Quantified from observation of effect on earth's surface, human, objects and man-made structures	Base-10 logarithmic scale obtained by calculating logarithm of the amplitude of waves.
Scale	I (not felt) to XII (total destruction)	From 2.0 to 10.0+ (never recorded). A 3.0 earthquake is 10 times stronger than a 2.0 earthquake
Consistency	Varies depending on distance from epicentre.	Varies at different distances from the epicentre, but one value is given for the earthquake as a whole.

SEISMIC BELTS ACROSS THE WORLD:



THE MOST IMPORTANT SEISMIC BELTS AROUND THE WORLD ARE AS UNDER:

1.) Circum-Pacific Belt: The Belt includes the coastal margins of **North America, South America and East Asia.** These are as represent the eastern and western margins of the Pacific Ocean respectively, and account for **about 65 per cent of the total earthquakes of the world.**

- **Western marginal zones:** represented by the Rockies & the Andes mountain chains. These are also the zones of convergent plate boundaries where the Pacific oceanic plate is subducted below the American plates.
- **Eastern marginal zones:** represented by the island arcs of Kamchatka, Sakhalin, Japan and Philippines. The earthquakes are caused due to collision of the Pacific and the Asiatic plates and the consequent volcanic activity.

2.) Mid-Continental Belt: Includes the Alpine mountains and their off shoots in Europe, Mediterranean Sea, northern Africa, eastern Africa and the Himalayas. The Mid-Continental Belt extends through Suleiman and Kithar zones in the west, the Himalayas in the north and Myanmar in the east. About 21 per cent of the total seismic events are recorded in this belt.

3.) Mid-Atlantic Ridge Belt: The Mid-Atlantic Ridge Belt includes the Mid-Atlantic ridge and several islands near the ridge. It records moderate earthquakes which are caused due to the moving of plates in the opposite directions. Thus, the seafloor spreading and the fissure type of volcanic eruptions cause earthquakes of moderate intensity in this region.

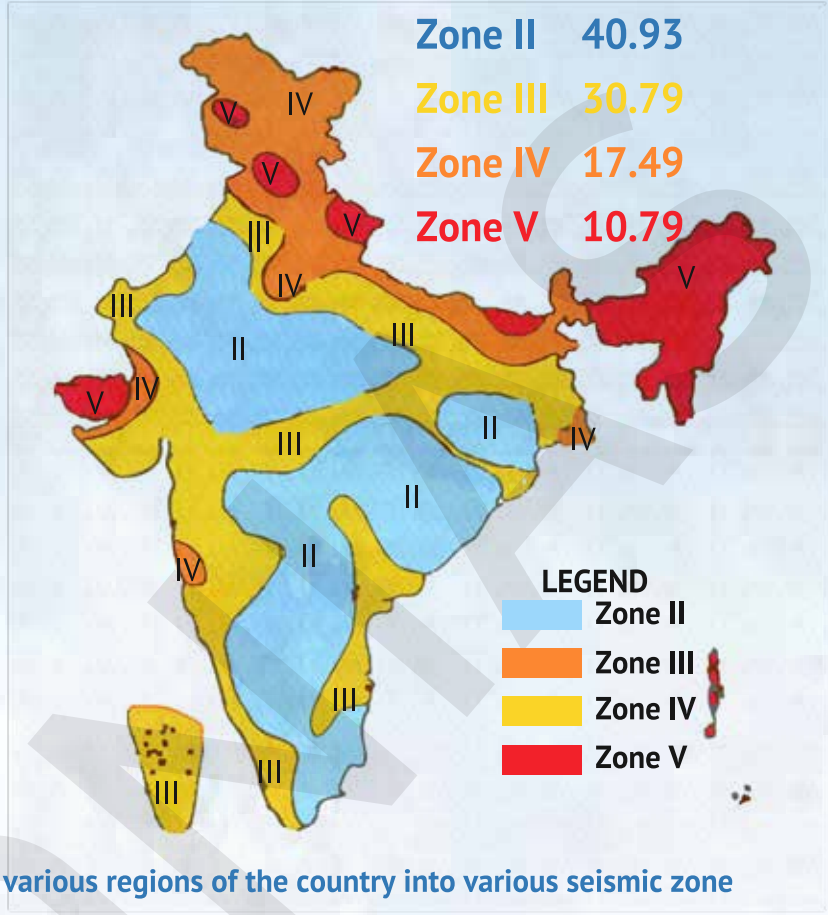
SEISMIC MAP AND ZONES OF INDIA

Seismic Zone Map of India: -2002

About 59 percent of the land area of India is liable to seismic hazard damage

Zone	Intensity
Zone V	Very High Risk Zone Area liable to shaking intensity IX (and above)
Zone IV	High Risk Zone Intensity VIII
Zone III	Moderate Risk Intensity VIII
Zone II	Low Risk Zone VI (and lower)

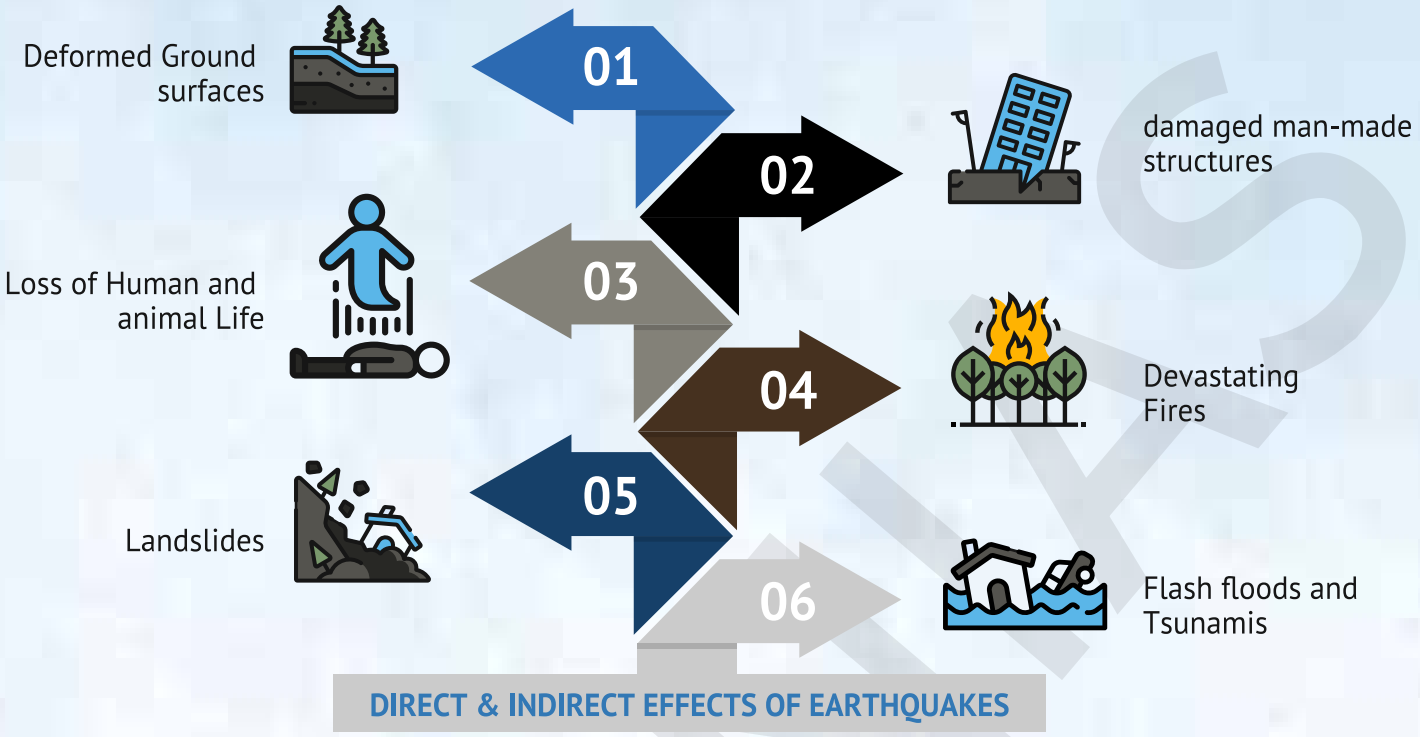
Seismic Zones in India



The following table gives the distribution of various regions of the country into various seismic zone

Zone	Damage risk	Region
Zone V	Very high damage risk zone	The entire North-east, including the seven sister states, the Kutch district, parts of Himachal and Jammu & Kashmir, and the Andman and Nicobar islands.
Zone IV	High damage risk zone	Parts of the Northern belt starting from Jammu and Kashmir to Himachal Pradesh. Also including Delhi and parts of Haryana. The Koyna region of Maharashtra is also in this zone.
Zone III	Moderate damage risk zone	A large part of the country stretching from the North including some parts of Rajasthan to the South through the Konkan coast, and also the Eastern parts of the country.
Zone II	Low damage risk zone	These two zones are contiguous, covering parts of Karnataka, Andhra Pradesh, Orissa, Madhya Pradesh, and Rajasthan, know as low risk earthquake zones.

DIRECT AND INDIRECT EFFECTS OF EARTHQUAKES



DIRECT & INDIRECT EFFECTS OF EARTHQUAKES

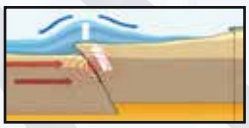
WHAT IS A TSUNAMI AND HOW IS IT FORMED?

Tsunami is a Japanese word which means 'harbour wave'. It is a series of traveling ocean waves of **extremely long length** generated by disturbances associated **primarily with earthquakes** occurring below or near the ocean floor. **Underwater volcanic eruptions and landslides can also generate** tsunamis.

THE PROCESS OF THE TSUNAMI

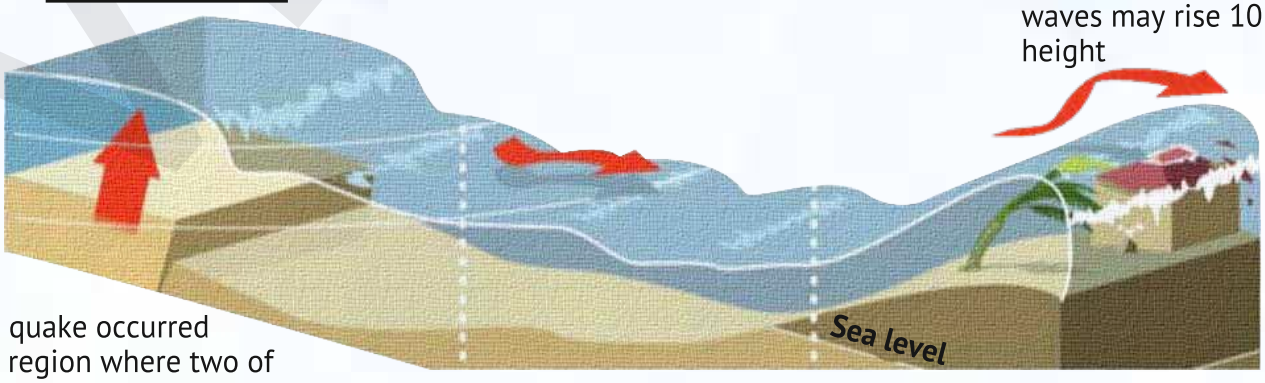
ANATOMY OF A TSUNAMI

1. The tsunami formed when an earthquake vertically shifted the seabed by several metres, displacing hundreds of kilometres of sea water
2. Large waves began rippling across the ocean, away from the earthquake's epicentre
3. In deep water, the tsunami moved at speeds of up to 800 km/h. When it approached shallower coastal areas, it slowed down but increased in height



How Tsunami work: Tsunamigenesis

when tsunami nears shore, waves may rise 10 times in height



The quake occurred in a region where two of the earth's tectonic plates push together, forcing one underneath the other

A TSUNAMIC EVENT: CAUSES, FACTORS AND IMPACTS

Tsunamis generally are caused by earthquakes. **Not all earthquakes generate tsunamis.** To generate tsunamis, earthquakes must occur underneath or near the ocean, be large and create movements in the sea floor.

All oceanic regions of the world can experience tsunamis, **but in the Pacific Ocean there is a much more frequent occurrence of large, destructive tsunamis because of the many large earthquakes along the margins of the Pacific Ocean**

Offshore and coastal features can determine **the size and impact** of tsunami waves. Reefs, bays, entrances to rivers, under sea features and the slop of the beach all help to modify the tsunami as it attacks the coastline.

In the open ocean a tsunami is less than a few feet high at the surface, **but its wave height increases rapidly in shallow water.** Tsunamis wave energy extends from the surface to the bottom in the deepest waters.

As the tsunami attacks the coastline, the **wave energy is compressed into a much shorter distance creating destructive, life-threatening waves.**